

Serial No: 09/474,031

Attorney Docket No: 113435

REMARKS**Invention**

The present invention is directed to a network restoration technique. In preferred embodiments of the invention, communications traffic between a pair of end nodes is routed over a particular path, or route, through the network. That path may experience a failure or error condition at any point along the path. However, a specific restoration path through the network has already been chosen as the path over which the traffic in question will be routed in the event of a failure or error condition. Thus when a failure or error condition occurs, the restoration route is already known. However, the particular channels within the links along the restoration routes that will be used to carry the traffic in question are not pre-chosen and are not known prior the failure or error condition. Rather, the channels are chosen after the failure or error condition occurs.

In particular applications, such as optical networks, an end node of the path can determine that a failure or error condition has occurred somewhere on the path. However, it is very difficult, if not impossible, to know just where along the path the failure or error condition may have occurred. Accordingly, preferred embodiments of the invention contemplate that the restoration process will be initiated by one or both of a path's end nodes—rather than a node somewhere in the middle of the path—upon the end node determining that a failure or error condition occurred. Moreover, the invention contemplates that the original path and the restoration path are disjoint. This means that, except for the endpoints, the two routes do not share any links or any nodes (e.g., cross-connects) in common. Thus when the original path fails and traffic is rerouted to the restoration path, there is no possibility that the restoration path will include one of those failed links or nodes. Advantageously, this obviates the need to know where the failure or error condition occurred.

Serial No: 09/474,031

Attorney Docket No: 113435

Chao Contrasted with Applicants

The pending claims in the application were rejected as being anticipated by Chao.

Chao is also directed to network restoration. For the most part, Chao is concerned with link-based restoration, meaning the establishment of a path, or route, around a single failed link. (Chao uses the term "span" to refer to that which applicants refer to as a link.) Chao identifies different possible restoration routes as shown in TABLE 2 (col. 12) of the Chao specification. Upon a failure or error condition occurring in a span between two nodes, Chao must determine where the failure or error condition occurred, so that a particular one of the previously-identified restoration routes can be chosen that does not include the failed span. As seen in TABLE 2, for example, the route D-C-B-A-D can be used to protect span D-C or span A-D, meaning that if, say, span D-C fails, then traffic that had been routed over that span could be routed from node D to node C via the route D-A-B-C. Restoration is thus not, in general, imitated by an end node but, rather, by a node that is immediately adjacent to the failure or error condition. (Of course, the imitating node could be an end node if the failure or error condition happened to be adjacent to that node.) Once the restoration route has been chosen, Chao goes ahead to select channels within the spans of the chosen route. (Chao uses the term "link" to refer to that which applicants refer to as a "channel.")

The above-described aspect of Chao does not address the restoration of an entire path, as is the case with applicants' invention. Rather, the above-described aspect of Chao addresses the rerouting of traffic around a particular failed span. Chao does seem to address path-based restoration based on an extension of the span-based technique described above. See, for example, col. 16, lines 23-50. However, Chao cannot predefine a particular restoration route that will be used because Chao does not teach or incorporate the notion that the potential restoration path is node- or span-disjoint with the original path that it may be called upon to replace. Thus Chao

Serial No: 09/474,031

Attorney Docket No: 113435

must first identify the location of the failure along a given route so as to be sure that the restoration route that is used does not include the failed span. This is indicated at, for example, col. 16, lines 45-50 as follows:

When a failure occurs in a path-based restoration system according to the teachings of the present invention, custodial nodes to the failed link need to identify the affected span to path termination nodes so that routes containing the failed span will not be selected for inclusion in a restoration route.

In view of the foregoing, one can see that there are at least four important differences between applicants' preferred embodiment and Chao:

- 1) Applicants' original and restoration paths are disjoint, whereas Chao's are not.
- 2) Applicants invention selects, before a failure or error condition occurs, the specific restoration route that will be used in the event of a failure or error condition. Chao, by contrast, would need to identify a number of possible restoration routes prior to a failure or error condition and the specific route to be used is selected only after the failure or error condition has occurred and the failed link (or node) can be identified. *See, in particular, the above-quoted passage from Chao.*
- 3) In applicants' preferred embodiments, occurrence of an error condition is detected at one or more of the path end nodes. In Chao, by contrast, a failure or error condition is detected at a node adjacent to the failure or error condition
- 4) In applicants' preferred embodiments, the restoration process is initiated by the path end nodes once those nodes have determined that a failure or error condition has occurred somewhere along the path. In Chao, by contrast, a node adjacent to the failure or error condition initiates the restoration process.

Claim Rejections are Traversed

Claims 1, 3-5, 7-13 and 15-38 were rejected as being anticipated by Chao. This rejection is respectfully traversed.

Serial No: 09/474,031

Attorney Docket No: 113435

Independent Claims

The rejection of each of applicants' independent claims, and thus of all of applicants' claims, is respectfully traversed, for at least the following reasons, corresponding to points 1) - 4) noted above:

1) Each of applicants' independent claims 1, 13, 21, 25, 28, 31, 34 and 37—both as originally filed and as currently amended—recite that the first and second paths are disjoint, either specifically via the use of the term “disjoint” or with other language. As noted above, this is not the case in Chao. Thus on this basis alone it is submitted that the claims distinguish the invention from Chao. See, in particular, claim 1, lines 14-15; claim 13, lines 13-14; claim 21, lines 5-6; claim 25, line 12; claim 28, lines 15-16; claim 31, line 7, claim 34, line 7; and claim 37, lines 7-8.

2) Each of applicants' independent claims as originally filed had recited that the restoration path had been identified prior to a failure or error condition. Claim 1, for example, recited at lines 11-12 “the second path having been determined before the error condition is detected.” Applicants intend this recitation to limit applicants' invention to the case where it is known prior to a failure or error condition exactly which route is going to be used for restoration if a failure or error condition actually does occur. In Chao, by contrast, no path is actually chosen to carry the rerouted signal until after the error condition is detected. This is a second basis on which applicants hereby traverse the rejection based on Chao.

In order to even more clearly point out this aspect of the invention and to even more clearly distinguish the invention from Chao, claim 1 has been amended at lines 11-12 to state that the second path is “chosen, before the error condition was detected, to carry the rerouted communication signal.”

Each other independent claim has been amended to similar effect.

3) As originally filed, applicants' independent claims 1 and 13 had recited that the error condition was detected at at least one of the end nodes. Applicants had

Serial No: 09/474,031

Attorney Docket No: 113435

intended this recitation to encompass the case where the error condition was detected at an end node even if the error condition was not adjacent to the end node. It will be recalled that in Chao, it is the node(s) that are adjacent to a failure or error condition—not the end node(s)—that detect that the failure or error condition occurred. This is a third basis on which applicants hereby traverse the rejection of claims 1 and 13 based on Chao.

In order to even more clearly point out that aspect of the invention and to even more clearly distinguish the invention from Chao, claim 1 has been amended to be specifically addressed to the case where the error condition is not adjacent to the detecting node. Specifically, amended claim 1 recites at lines 7-8 “said error condition being not adjacent to said at least one node.”

Claim 13 has also been amended to more clearly point out this same aspect of the invention. Specifically, amended claim 13 recites at lines 6-8 “an error detecting device ... for detecting the occurrence of an error in any portion of said first communication path.”

4) Furthermore, consistent with point 4) set forth above, claim 1 has been further amended at line 9 to recite that the rerouting is initiated by “said at least one end node.”

In view of the foregoing, it is submitted that each of applicants’ independent claims, and thus each of applicants’ dependent claims as well, distinguish the invention from Chao.

Dependent Claims

Various ones of the dependent claims heretofore presented in the application further distinguish the invention from Chao.

Claim 3, for example, includes limitations directed to the sending of back-off commands. Although col. 9, lines 58-64 of Chao were cited in the Office action as teaching the sending of back-off commands as recited in claim 3, applicants do not

Serial No: 09/474,031

Attorney Docket No: 113435

find anything in the cited passage relating to the send of back-off commands. See, by contrast, applicants' specification at, for example, p. 15, lines 16-21.

Claim 4, for example, includes limitations directed to the first and second end nodes coordinating the rerouting over the second path. Although col. 11, lines 58-65 of Chao were cited in the Office action as teaching this aspect of the invention, applicants do not find anything in the cited passage that describes the rerouting being undertaken by the end nodes acting in coordination. See, by contrast, applicants' specification at, for example, p. 15, lines 10-13.

Claims 7-10, 17, 18, 22, 26, 29, 33, 36 and 38 include limitations directed to various specific channel assignment mechanisms including, in some of these claims, the assigning of channels within the predefined route in two directions simultaneously, i.e., from both of the end nodes towards the middle of the path. See, for example, p. 14, line 10 et seq. of applicants' specification. Applicants do not find anything in the various cited passages of Chao relative to these claims that disclose the aspects of the invention defined by these claims.

The foregoing provides a further basis for the allowability of various ones of applicants' dependent claims.

Claim 19 has been amended to improve its form by changing "uses" to "is" in line 2.

New Dependent Claims

Various ones of new claims 39-44, which depend from independent claims 21, 25, 28, 31, 34 and 37, respectively, are directed to one or both of the third and fourth distinguishing aspects of the invention noted above—specifically, that the end nodes a) detect the occurrence of a failure or error condition and b) initiate the rerouting.

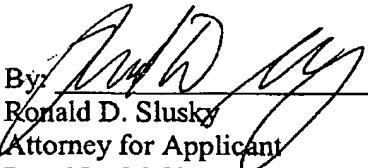
Serial No: 09/474,031

Attorney Docket No: 113435

In view of the foregoing, it is believed that all the claims in the application are in condition for allowance, which action and passage of the application to issue are earnestly solicited.

Respectfully submitted,

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